

Remarks

Reconsideration of this Application is respectfully requested.

Upon entry of the foregoing amendment, claims 1-31 are pending in the application, with 1, 5, 7, 8, 16, 20, 21 and 23-31 being the independent claims. Claims 1-3, 5, 7, 8, 16, 20, 21 and 23-28 are amended. Claims 29-31 are added. These changes are believed to introduce no new matter, and their entry is respectfully requested.

In the Office Action dated April 15, 2003, claims 1-4, 9-11, 13, 14, 18, 19, 27 and 28 stand rejected under 35 U.S.C. § 102(b) as being allegedly anticipated by Herrell *et al.*, U.S. Patent No. 4,860,444. Claims 12, 15 and 22 stand rejected under 35 U.S.C. § 103(a) as being allegedly unpatentable over Herrell *et al.* Claims 5-8, 16, 17, 20, 21 and 23-26 are indicated as being allowable if rewritten in independent form.

Based on the above amendment and the following remarks, Applicant respectfully requests that the Examiner reconsider all outstanding objections and rejections and that they be withdrawn.

Allowable Claims 5-8, 16, 17, 20, 21 and 23-26

Applicant thanks the Examiner for indicating the allowability of several pending claims. Claims 5-8, 16, 17, 20, 21 and 23-26 are indicated as being allowable if rewritten in independent form. Claims 5, 7, 8, 16, 20, 21 and 23-26 have been rewritten in independent form, as suggested by the Examiner. Accordingly, Applicant respectfully requests that the objections to claims 5-8, 16, 17, 20, 21 and 23-26 be withdrawn.

Rejections under 35 U.S.C. § 102/103 based on Herrell et al.

A number of claims stand rejected as being allegedly anticipated by Herrell *et al.*, or, alternatively, as being obvious over Herrell *et al.* Although Applicant does not necessarily agree with the reasoning expressed in the Office Action, independent claim 1 has been amended to recite the use of lithographic compliant interconnect. At least this aspect of the invention of claim 1 is not taught or suggested in the cited reference. FIGs. 2 and 3 of Herrell *et al.*, and the corresponding description in the specification, *e.g.*, column 5, lines 56-67, do not teach or suggest the use of lithographically formed compliant interconnects, even if, *arguendo*, element 38 in FIG. 2 were to be treated as a compliant interconnect. Accordingly, claim 1, as amended, is allowable over Herrell *et al.*

Independent claims 27 and 28 have also been amended to recite the use of lithographic compliant interconnects. These claims are allowable at least for the reasons applicable to claim 1, as well as due to the features recited therein.

The dependent claims that depend from claim 1 are allowable at least because their base claim, claim 1, is allowable, as well as due to the features recited therein.

New claims 29-31

New independent claims 29-31 are added.

Claim 29 is directed to the aspect of “the compliant interconnects including non-contacting compliant interconnects.” Support for the language of this claim may be found, for example, in paragraph 0060 and FIG. 4C of the present application. At least this aspect is not disclosed in Herrell *et al.* Accordingly, claim 29 is allowable over the cited reference at least for this reason, as well as due to the features recited therein.

Claim 30 is directed to the aspect of “compliant interconnects within the cavity such that the compliant interconnects exert pressure to keep the die in place.” Support for the language of this claim may be found, for example, in paragraph 0063 and FIG. 6 of the present application. At least this aspect is not disclosed in Herrell *et al.* Accordingly, claim 30 is allowable over the cited reference at least for this reason, as well as due to the features recited therein.

Claim 31 is directed to the aspect of “a top substrate, a bottom substrate and a cavity between the top and bottom substrates, the substrates coupled to each other using compliant interconnects located within the cavity; [and] at least one die within the cavity and bonded to the top substrate.” Support for the language of this claim may be found, for example, in paragraph 0059 and FIG. 4B of the present application. At least this aspect is not disclosed in Herrell *et al.* Accordingly, claim 31 is allowable over the cited reference at least for this reason, as well as due to the features recited therein.


Conclusion

All of the stated grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider all presently outstanding objections and rejections and that they be withdrawn. Applicant believes that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

Prompt and favorable consideration of this Amendment and Reply is respectfully requested.

Respectfully submitted,

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A handwritten signature in black ink, appearing to read 'Michael V. Messinger', written over a horizontal line.

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Version with markings to show changes made

In the claims:

Please amend claims 1-3, 5, 7, 8, 16, 20, 21 and 23-28 as follows:

1. (Twice Amended) A cooling assembly comprising:

an electronic package having a cavity;

at least one die with active electronic components mounted using lithographic
compliant interconnects within the cavity; and

at least one coolant port that allows a coolant to enter the cavity and directly cool
the active electronic components of each die.

2. (Amended) The cooling assembly of claim 1, wherein the [package further includes
compliant interconnects within the cavity, and] lithographic compliant interconnects are
coupled between each die and the package.

3. (Amended) The cooling assembly of claim 2, wherein said lithographic compliant
interconnects comprise spring contacts.

5. (Amended) [The cooling assembly of claim 3,] A cooling assembly comprising:

an electronic package having a cavity;

at least one die with active electronic components mounted using compliant
interconnects within the cavity; and

at least one coolant port that allows a coolant to enter the cavity and directly cool

the active electronic components of each die,

wherein the compliant interconnects are coupled between each die and the package,

wherein said compliant interconnects comprise spring contacts, and

wherein said spring contacts comprise lithographic springs.

7. (Amended) [The cooling assembly of claim 2,] A cooling assembly comprising:

an electronic package having a cavity;

at least one die with active electronic components mounted using compliant interconnects within the cavity; and

at least one coolant port that allows a coolant to enter the cavity and directly cool the active electronic components of each die,

wherein the compliant interconnects are coupled between each die and the package, and

wherein each die has at least one active surface, and when the coolant circulates in the cavity the coolant directly cools each active surface of each die.

8. (Amended) [The cooling assembly of claim 2,] A cooling assembly comprising:

an electronic package having a cavity;

at least one die with active electronic components mounted using compliant interconnects within the cavity; and

at least one coolant port that allows a coolant to enter the cavity and directly cool the active electronic components of each die,

wherein the compliant interconnects are coupled between each die and the package, and

wherein each die has a plurality of surfaces within the cavity including at least one active surface associated with respective active electronic components, and when the coolant circulates in the cavity the coolant directly cools each surface of each die, thereby reducing thermal gradients or hot spots on each active surface of each die and increasing the operating range of each die.

16. (Amended) [The cooling assembly of claim 2,] A cooling assembly comprising:
an electronic package having a cavity;
at least one die with active electronic components mounted using compliant
interconnects within the cavity; and
at least one coolant port that allows a coolant to enter the cavity and directly cool
the active electronic components of each die,
wherein the compliant interconnects are coupled between each die and the
package, and

wherein said package further comprises[:] a bottom substrate on one side of the cavity, wherein each die with active electronic components is connected to the bottom substrate by the compliant interconnects, and wherein the active electronic components face the bottom substrate and contact coolant surrounding the compliant interconnects within the cavity.

20. (Amended) [The cooling assembly of claim 2,] A cooling assembly comprising:
an electronic package having a cavity;

at least one die with active electronic components mounted using compliant interconnects within the cavity; and

at least one coolant port that allows a coolant to enter the cavity and directly cool the active electronic components of each die,

wherein the compliant interconnects are coupled between each die and the package, and

wherein said package further comprises a top substrate with a top surface representing an exterior surface of the package and wherein the top surface includes contacts, whereby external components can be electrically coupled to each die via the contacts.

21. (Amended) [The cooling assembly of claim 2,] A cooling assembly comprising:

an electronic package having a cavity;

at least one die with active electronic components mounted using compliant interconnects within the cavity; and

at least one coolant port that allows a coolant to enter the cavity and directly cool the active electronic components of each die,

wherein the compliant interconnects are coupled between each die and the package, and

wherein said package further comprises:

a top substrate;

a bottom substrate; and [further comprising:]

interconnection elements that provide electrical paths extending through the top substrate and the bottom substrate.

23. (Amended) [The cooling assembly of claim 2,] A cooling assembly comprising:
an electronic package having a cavity;
at least one die with active electronic components mounted using compliant
interconnects within the cavity; and
at least one coolant port that allows a coolant to enter the cavity and directly cool
the active electronic components of each die,
wherein the compliant interconnects are coupled between each die and the
package; [further comprising:] and
a coolant circulation system coupled to said at least one coolant port, wherein the
coolant circulates within the package and directly contacts all surfaces of each die to directly
cool active electronic components during their operation.
24. (Amended) [The cooling assembly of claim 2,] A cooling assembly comprising:
an electronic package having a cavity;
at least one die with active electronic components mounted using compliant
interconnects within the cavity; and
at least one coolant port that allows a coolant to enter the cavity and directly cool
the active electronic components of each die,
wherein the compliant interconnects are coupled between each die and the
package; [further comprising:]
a cooling member; and
one or more heat radiators, wherein each die is immersed in the coolant and each heat
radiator transfers heat generated by each die from the coolant to said cooling member.

25. (Amended) [The cooling assembly of claim 2,] A cooling assembly comprising:
an electronic package having a cavity;
at least one die with active electronic components mounted using compliant
interconnects within the cavity; and
at least one coolant port that allows a coolant to enter the cavity and directly cool
the active electronic components of each die,
wherein the compliant interconnects are coupled between each die and the
package; [further comprising] and
at least one non- contacting compliant interconnect coupled to a surface of said at
least one die, whereby, heat can be further directed away from the surface of a die.

26. (Amended) [The cooling assembly of claim 2,] A cooling assembly comprising:
an electronic package having a cavity;
at least one die with active electronic components mounted using compliant
interconnects within the cavity; and
at least one coolant port that allows a coolant to enter the cavity and directly cool
the active electronic components of each die,
wherein the compliant interconnects are coupled between each die and the
package, and
wherein said package further comprises:
a top substrate; and
a bottom substrate[;],
wherein each die is flip-chip bonded to said top substrate.

27. (Amended) A method for direct cooling of active electronic components, comprising:

coupling active electronic components through lithographic compliant interconnects to a substrate of a package such that the active electronic components face the substrate;

sealing the attached active electronic components and compliant interconnects within a cavity of the package; and

circulating coolant through the package cavity to directly contact the active electronic components.

28. (Twice Amended) A cooling assembly, comprising:

means for sealing at least one die with active electronic components in a package the die mounted within this package using lithographic compliant interconnects; and

means for circulating coolant through the package during operation of the active electronic components to reduce thermal variations across each die.

New claims 29-31 are added.